

We claim:

1. A method of digitally watermarking visual media comprising:
passing a reference image and a watermarked image through a model of an output device;

5 passing the output of the model of the output device to a visual quality metric; and
 using the output of the quality metric to adjust watermark embedding to achieve a
desired visual quality in a watermarked image.

2. The method of claim 1 wherein the visual media comprises an image to be
10 printed and the model is a model of a printing process.

3. The method of claim 1 wherein the visual media comprises video to be
displayed and the model is a model of a display device.

15 4. The method of claim 1 including:
 applying the model of the output device and visual quality metric iteratively to
adjust the watermark embedding.

5. The method of claim 1 wherein the visual quality metric is used to produce a
20 visibility map, and the visibility map is input to the watermark embedding to adjust areas
of the digital watermark so as to compensate for an effect of the output device on visual
quality of the watermarked image.

6. The method of claim 1 wherein the visual quality metric evaluates a
25 watermarked image relative to an original un-watermarked image to identify areas in the
watermarked image where an embedded digital watermark is more or less visible.

7. A storage medium on which is stored instructions for performing a method of
digitally watermarking visual media, the method comprising:

passing a reference image and a watermarked image through a model of an output device;

passing the output of the model of the output device to a visual quality metric; and

using the output of the quality metric to adjust watermark embedding to achieve a

5 desired visual quality in a watermarked image.

8. A method of digitally watermarking a signal comprising:

passing a reference signal and a watermarked signal through a model of an output device;

10 passing the output of the model of the output device to a perceptual quality metric; and

using the output of the quality metric to adjust watermark embedding to achieve a desired perceptual quality in a watermarked signal.

15 9. The method of claim 8 wherein the model of the output device models an effect of an audio rendering process.

10. The method of claim 8 wherein the model of the output device models an effect of a video rendering process.

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11. The method of claim 8 wherein the model of the output device models an effect of a printing process.

12. The method of claim 8 wherein the output of the quality metric is used to
25 adjust strength of digital watermark embedding in areas of the watermarked signal where the perceptual quality metric determines that a digital watermark is more or less perceptible than desired.

13. The method of claim 12 wherein the adjusting is performed by providing output from the quality metric to input of a digital watermark embedding process.

14. The method of claim 13 including providing output from the quality metric to the digital watermark embedding process in a visibility map used to adjust strength of digital watermark embedding in areas of the signal.

15. The method of claim 12 wherein the adjusting is performed iteratively by repeatedly applying the model of the output device and the quality metric to watermarked signals and using output of the quality metric to adjust the watermark embedding until a desired perceptual quality of the watermarked signal is attained.

16. A storage medium on which is stored instructions for performing a method of digitally watermarking a signal, the method comprising:

15 passing a reference signal and a watermarked signal through a model of an output device;

 passing the output of the model of the output device to a perceptual quality metric; and

20 using the output of the quality metric to adjust watermark embedding to achieve a desired perceptual quality in a watermarked signal.